


2nd check P-loop

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7.4 Determination of TTCS volume

Confirmation by gas expansion

2nd check (quick)

TTCS volume determination								
Date: 28/10/2009		Company: SYSU		Location: CERN		Engineer: SXH, ZZ		
Step No.	Action and Description			Monitoring	Value	Result	Comment	Time
22.	Take by hand environment conditions							
23.	Temperature: <input type="checkbox"/> 22°C	Humidity: %RH	Pressure: MPa					
24.	Affix any two of the three PT1000s on the side surface of the SV1.5. and leave the rest one to monitor environmental temperature.					OK		7:50
25.	Connect the SV1.5 (any of the three stand vessels can be used) to connector 3; Note: Longer extend tube may be used and height difference may exist between the SV1.5 and connector 3. <u>Note: The extend tube between connectors and valves must be supported to reduce strain.</u> (For the new connectors, wrench screw nuts with one and quarter circles. For the used connectors, wrench the screw nuts further tightly.)					OK		7:50
26.	Connect the N ₂ bottle to connector 2;					OK		7:50

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TTCS volume determination						
Date:		Company:		Location:		Engineer:
Step No.	Action and Description	Monitoring	Value	Result	Comment	Time
27.	Connect a dry mechanical pump to vacuum connector			OK		7:55
28.	Connect the TTCS loop to connector 1; Longer extend tubes may be used and height difference may exist between the TTCS loop and connector 1. <u>Note: The extend tube between connectors and valves must be supported to reduce strain.</u>			OK		7:50.
29.	Close valve 1, valve 4 and the N ₂ bottle valve, open valve 2, valve 3, the SV1.5 valve, pressure regulator and the vacuum valve slowly, pump the SV1.5 and the filling box down to 30Pa;	Evacuate Time Vacuum gauge reading	1~2 hours ≤30Pa			8:00
30.	Close the vacuum valve open the valve of the N ₂ bottle					
31.	Fill the SV1.5 with N ₂ up to 4.5MPa, then close valve 2; waiting until pressure and temperature of the standard vessel is stable. Take by hand the pressure as P ₁ . Take by hand the average reading of the three PT1000s in the filling system as T ₁ . (here T ₁ is comparable to T _{room} with range of ±1°C);	Evacuate Time P ₁ No.1 Pt1000 No.2 Pt1000 No.3 Pt1000	0.5~1hours T _{room} ±1°C T _{room} ±1°C T _{room} ±1°C	5.305MPa 23.80°C~23.9°C 23.5°C		8:15

Remark: the SV1.5 already filled with N₂, so just vacuum the extend tube)

22.80°C~22.9°C (room temperature)

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TTCS volume determination						
Date:		Company:		Location:		Engineer:
Step No.	Action and Description	Monitoring	Value	Result	Comment	Time
32.	Close the filled SV1.5 valve, valve 3, and the N ₂ bottle valve, disconnect the filled SV1.5 from connector 3;					
33.	Weight the filled SV1.5 with an electronic balance (0.1g precision or better), as M _{Nitrogen} ;	} Gas exposure, without disconnect the SV1.5				
34.	Connect the filled SV1.5 back to the connector 3;					
35.	Open valve 3, valve 1, valve 4 and the vacuum valve; open pressure regulator to pump the filling box and TTCS loop down to 30Pa;					
36.	Close the vacuum valve, valve 1 and valve 4, switch off the pump. Open the SV1.5 valve and close SV1.5 valve, slowly open valve 1 to fill the N ₂ into the TTCS loop to prevent pressure spike to the sensors. Repeating on and off the SV1.5 valve and valve 1 in turn until pressure of the TTCS loop is up 1.5MPa, and then slowly open the SV1.5 valve and valve.	DPS reading of the TTCS loop	≤0.5Bar	100Pa	<0.5Bar	8:36

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TTCS volume determination

TTCS volume determination						
Date:		Company:		Location:		Engineer:
Step No.	Action and Description	Monitoring	Value	Result	Comment	Time
37.	Wait a period of time (0.5~1hours), take by hand the loop pressure as P2 and the average reading of the three PT1000s in the filling system as T ₂ . (here T ₂ is comparable to T _{room} with range of ±1°C);	P2 No.1 Pt1000 No.2 Pt1000 No.3 Pt1000	T _{room} ±1°C T _{room} ±1°C T _{room} ±1°C	2.645MPa 22.2°C. 21.3°C 22.9°C	T _{avg} = 22.44°C T _{bulb} = 21.88°C	8:56
38.	Close valve 1, valve 3, SV1.5 valve and the TTCS valve;					
39.	Disconnect SV1.5 from the connector 3;					
40.	Weight the SV1.5 with the electronic balance again, as M _{nitrogen2} ;					
41.	The nitrogen mass inside the loop and the filling system is: M _{nitrogen} = M _{nitrogen1} - M _{nitrogen2} ;					
42.	The volume of the loop is determined by the ideal gas equation, where $V_{Loop} = \frac{M_{nitrogen} RT_2}{m_{nitrogen} P_2} - V_{FT}$					
43.	Determine the fill mass by M _{C_L} = V _{Loop} FR (where FR = 569.60 g/l). m _{nitrogen} = 28g/mol for nitrogen, and R is the gas constant;					

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= 1.438L

2.645MPa


5.305MPa · 1.438L

-1.487L - 0.0619L

(2.645MPa) (±5.38%)

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Date:		Company:		Location:		Engineer:
Step No.	Action and Description	Monitoring	Value	Result	Comment	Time
44.	Calculate the filled mass for the standard vessel Set $M_{C_{vs}} = M_{E_{vs}} + M_{C_L} + M_{C_R}$; NOTE: $M_{C_R} = M_{C_{R_{vs}}} + M_{C_{R_{FT}}} = V_{vs} \times \rho_G(T, P) + V_{FT} \times \rho_G(T, P)$ Here $\rho_G(T, P)$ is determined by the chosen final temperature of the standard vessel and the final saturated pressure of the TTCS loop.					
45.	Repeat the above procedure of TTCS volume determination again for confirmation					

7.5 Fill a standard vessel with CO₂ from a Gas bottle

Fill a standard vessel with CO ₂ from a Gas bottle						
Date:		Company:		Location:		Engineer:
Step No.	Action and Description	Monitoring	Value	Result	Comment	Time
1.	Take by hand environment conditions					
2.	Temperature: <input type="checkbox"/> Humidity: %RH Pressure: MPa					

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